MORTALITY AMONG FORMER EMPLOYEES OF THE DOMTAR PIPE FACTORY IN CORNWALL, ONTARIO

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EXECUTIVE SUMMARY

On July 5, 1982 a former employee of Domtar Construction Limited in Cornwall, Ontario appeared before The Royal Commission on Matters of Health and Safety Arising from the Use of Asbestos in Ontario. In a letter to the Ministry of Labour, on December 22, 1982, the Commission's Executive Co-ordinator outlined the worker's concerns. The man, who was employed at Domtar from 1951-1977, approached the Royal Commission because he felt that he and several co-employees were exposed to asbestos and that this had resulted in respiratory problems and deaths. The Commission asked the Ministry of Labour for information about the Company and the workers on the witnesses list.

As a result of the request, the plant in Cornwall was visited by a physician from the Occupational Health Branch. He reported that the plant had been in place since 1929 and manufactured a pipe product from waste paper, chrysotile asbestos and coal tar pitch. The physician examined medical records at the plant and found that one death, due to pleural mesothelioma, strongly suggested an asbestos causation while another, due to a skin cancer of the scrotum, appeared to be related to exposure to coal tar pitch. He found a number of deaths to be due to other cancers, including lung cancer, but suggested that these could only be properly interpreted by the use of more sophisticated epidemiologic methods.

The author of this report met with Domtar officials in July of 1983 to assess the feasibility of a formal epidemiologic study of the mortality experience of Domtar workers. Although it appeared that some records had been lost it was decided to proceed with a study. The information received from the Company was submitted to Statistics Canada for a mortality search. Results of the search were received in March, 1987 and this report presents the results of the epidemiologic analysis.

Workers at the Domtar plant in Cornwall were exposed to 2 well known carcinogens, coal tar pitch and asbestos. It appears that at least 2 deaths among the workers, a skin cancer of the

scrotum and a mesothelioma of the pleura, were caused by these agents. In addition, there was excess mortality among the long term employees from both lung cancer and non-malignant respiratory disease, diseases potentially associated with exposure to asbestos. Case-control analyses found significant associations between death from these diseases and employment as a beater operator, an occupation specified by the Royal Commission witness as being one in which workers had particular risk of exposure to asbestos.

It may reasonably be concluded that exposure to asbestos has caused some excess mortality among the Domtar workers. Men who worked as beater operators or maintenance mechanics appear to be at particular risk.

In follow-up to this study, the actions listed below are suggested:

1) It is known that cigarette smoking increases the risk of disease among workers who have been exposed to asbestos and it is believed that smoking cessation will cause this increased risk to decline. It is thus suggested that Domtar employees who worked with asbestos be contacted, informed of the results of this study and advised about the hazards of smoking. It is suggested that particular effort be made to locate men who worked as beater operators or maintenance mechanics, to provide them with counselling about smoking, and to offer them a clinical examination to detect asbestosis, a compensable industrial disease.

2) The names of workers who died of lung cancer or respiratory disease will, with the permission of the Registrar General, be provided to the Ontario Workers' Compensation Board for their consideration.

3) It is suggested that the Ontario Cancer Registry be asked to periodically examine their records for the names of workers in this cohort so that the Compensation Board may be informed of cases of potentially compensable illness.

INTRODUCTION

On July 5, 1982 a former employee of Domtar Construction Limited in Cornwall, Ontario appeared before The Royal Commission on Matters of Health and Safety Arising from the Use of Asbestos in Ontario. In a letter to the Ministry of Labour, on December 22, 1982, the Commission's Executive Co-ordinator outlined the worker's concerns. The man, who was employed at Domtar from 1951-1977, approached the Royal Commission because he felt that he and several co-employees were exposed to asbestos and that this had resulted in respiratory problems and deaths. The worker, himself, had been on a long-term disability pension since 1977 for respiratory problems but, according to the worker, the pension was not associated with an asbestos condition because "the Company won't admit it". The worker named several dozen co-workers whom he felt were adversely affected by exposure to asbestos. The Commission asked the Ministry of Labour for information about the Company and the workers on the witnesses list.

As a result of the request, the plant in Cornwall was visited by a physician from the Occupational Health Branch on February 16, 1983. He reported that the plant had been in place since 1929. A product called "NoCoRode" pipe had been manufactured until 1974 and fire-resistant ceiling panels were produced from 1971 until the plant closed in December 1982. The pipe was made from waste paper and 2% chrysotile asbestos and was saturated with coal tar pitch. Respiratory protective devices were not worn by the workers until recent years, but gloves and aprons were said to be worn in the coal tar saturation area. A medical surveillance program for asbestos workers had been carried out by the Ministry of Labour since 1968.

The physician examined medical records at the plant and found that one death, due to pleural mesothelioma, strongly suggested an asbestos causation while another, due to a skin cancer of the scrotum, appeared to be related to exposure to coal tar pitch. He found a number of deaths to be due to other cancers, including lung cancer, but suggested that these could

only be properly interpreted by the use of more sophisticated epidemiologic methods. He reported that the workforce in this plant was relatively stable and varied from about 50 to 250 persons. It was estimated that a total of 1200 workers had been employed at the plant in its 53 year occupational history.

The author of this report met with Domtar officials at the plant in July of 1983 to assess the feasibility of a formal epidemiologic study of the mortality experience of Domtar workers. Although it appeared that some records had been lost, since the files of only about 500 workers could be found, it was decided to proceed with a study and the abstracting of worker records was begun. The information received from the Company was coded, edited, and submitted to Statistics Canada for a mortality search. Results of the search were received in March, 1987 and this report presents the results of the epidemiologic analysis.

DESCRIPTION OF THE FACTORY

In 1929 Domtar constructed a plant in Cornwall, Ontario for the manufacture of fibre conduit, used for the underground installation of electrical cables. The conduit was formed from the following raw materials: newsprint, asbestos, sulphite screenings, charcoal, and coal tar pitch. Five foot forming machines were in operation to form the conduit and a drying oven to dry the pipe. The pipe was saturated with hot pitch in an open vat which accommodated 5 kettles. Any necessary cutting and straightening was done "in the white", prior to saturating. After saturating, the conduit was trollied to the tooling room where a double end lathe was used for tooling the pipe and another lathe tooled couplings. The finished pipe was stored in the yard.

In early 1940 vacuum saturation was introduced which increased the strength and quality of the product. After the War, demand for fibre conduit increased sharply and a new mill was built in 1946. Pipe was produced in 8 foot lengths for the first time and a new product, known as "NoCoRode" pipe was placed on the market. So great was the demand for this product and the electrical conduit that a further expansion was made in 1954, followed by another expansion in 1956.

In 1954 demand for fibre pipe and conduit required that production go on a 24 hour, 7 day a week basis. This was quite different from the early period when day work only was carried on and for only 6 or 7 months of the year. A skeleton crew carried on the balance of the year. In the late fifties competition in the Canadian market increased and with the coming of plastic pipe on the market, sales were substantially reduced. Some cutbacks in manpower resulted, but the Company was able to maintain employment for a large percentage of the workforce.

The Company realized that eventually the fibre pipe would have to be phased out and looked for other products that could be produced at Cornwall. A non-combustible roof insulation (Board) plant was built in 1971. At the same time demand for fibre pipe decreased further and a decision was made to close

the Pipe Plant in 1976. The Board Plant continued in operation but the crew was much smaller. As a result of continuing losses the plant was closed permanently in December, 1982.

An Ontario government hygienist visited the plant in 1968 and found that 5-10% asbestos (Flintkote from Thetford Mines) was used in the pipe mix which also included scrap paper, cardboard, and diatomaceous earth. Materials used in 1967 included: newsprint (3356 tons); asbestos (484 tons); Diatomaceous earth (129 tons); pulp (59 tons); and coal tar pitch (513 tons). The factory processes were described by another hygienist in 1971. The process consisted of mixing paper, bentonite and asbestos to form a slurry from which 3" diameter pipes were formed. These were dried, the ends were cut, and the pipe material was sealed by dipping into heated coal tar pitch. The impregnated pipe would then have the ends turned for coupling fit or would be cut to length and have holes cut for use as weeping tile.

The forming and drying section of the pipe plant was about 100' x 200' with a ceiling at 14' in some places and 24' at others. The dust generating operation in that area was at the pipe cut-off. As the pipe came from the 2 ovens it was clamped and each end was cut to give the exact length. There was local exhaust at each cutting location which appeared to give good control. However when the pipe rolled down an incline from the cut-off there was some banging together of pipe at the stop position which caused dust.

Pipe impregnation and finishing were carried out in an adjoining room. The coal tar pitch was conditioned at an outside location and pumped into one of the five dip tanks which were located under the high part of the ceiling. The baskets containing the paper-mix pipes were dipped for a timed treatment. Odd sizes and shapes of pipe were manually handled for end finishing.

The hygienist commented that although asbestos was used in the mix it remained bagged until after it was wet so that there was little chance of exposure to asbestos dust at the mixing area. After the pipe was dried and cut off there was some

visible dust generated when pipes rolled down an incline and banged together. Fumes from the coal tar pitch tanks appeared to be well controlled by the ceiling exhaust vents.

According to the worker who testified before the Royal Commission, 40 tons of asbestos a month were used during the peak season. The asbestos was purchased from Johns-Manville and came from Thetford Mines, Quebec. The men who worked most in asbestos dust exposure were the lift truck drivers, who unloaded asbestos, and the beater operators, who handled 200 pounds of asbestos and 1000 pounds of paper per batch. There were 10-12 batches per shift during peak production.

The use of asbestos was discontinued in 1974. No air sampling or dust measurement was ever done at the plant.

STUDY METHODS

1) The Cohort of Workers

The list of workers was assembled from records stored at the plant. A long-term employee abstracted identifying information and job histories, and the data was coded for the computer in Toronto. Information for 472 former employees was provided, a number substantially less than the estimated total workforce of 1200 individuals. On examination it was found that there were records for only 16 individuals who had terminated employment prior to 1960. The Company advised us, after investigation, that no records were kept for employees terminated prior to 1960 because coverage under long term and short term disability was not provided prior to 1960. For this reason, and because at the time it was felt that such recordkeeping was not necessary, no files were kept. No seniority lists or insurance records could be found to supplement the files. It is not known why the 16 files from this era were kept.

The study cohort thus consists of the 447 men who were employed at the plant during 1960 or later, and contains 2 categories of individuals; those hired before 1960 who continued to work after 1959, and those hired for the first time after 1959. One hundred twenty-three of these workers started in 1974 or later and are assumed not to have been exposed to asbestos. The 10 women on the roll are excluded from the analysis because they did not work in asbestos exposure; no deaths were identified among them.

2) Tracing of the Workforce

Vital status of the workforce was ascertained by record linkage with the Canadian Mortality Data Base using the Generalized Iterative Record Linkage System (GIRLS) at Statistics Canada. Follow-up was provided to the end of 1985. In addition, the Company provided information about a number of deaths and a search was made of the Ontario Driver Licence

Registry for the date of the last transaction with the Registry.

3) Statistical Methods

Standard methods were used to compare mortality among the DOMTAR workers with that occurring among the general population of Ontario. Follow-up began in 1960 or at the time of hire, whichever came later. Person-years at risk were apportioned into latency intervals determined by the time since first employment and were calculated using the computer program "MANYRS" written by Professor J. Peto. The numbers of "expected" deaths were calculated from age and calendar-period adjusted Ontario rates using a computer program written by Robert Kusiak of the Ministry of Labour. Matched case-control analyses were performed using the "PECAN" computer program written by Barry Storer of the University of Washington.

RESULTS

1) The Cohort

The study cohort consists of the 447 men who were employed at the plant during 1960 or later, and contains 2 categories of individuals; those hired before 1960 who continued to work after 1959, and those hired for the first time after 1959. One hundred twenty-three of these workers started in 1974 or later and are assumed not to have been exposed to asbestos. The distribution of durations of employment is given in Table 1 below.

TABLE 1: EMPLOYMENT PATTERN OF THE WORKERS IN THE STUDY

Men who worked after January 1, 1960
and who started before 1974

LENGTH OF EMPLOYMENT:	< 1 YEAR	N= 68	GROUP 1
	1- <5 YEARS	N= 89	GROUP 2
	5-<10 YEARS	N= 37	GROUP 3
	>10 YEARS	N= 130	GROUP 4
123 men started after Jan 1 1974			GROUP 5

2) Cohort Analysis of Mortality

One death of note occurred among the 16 workers who were known to have left before 1960. This was a death of a 40 year old man in 1958 due to pleural mesothelioma. He began work in June, 1945 and worked as a beater operator.

No deaths occurred among the Group 1 workers employed for less than 1 year; 3 deaths would have been expected according to Ontario mortality rates.

Three deaths occurred among the Group 2 workers within 10 years of hire; 2 were due to non-occupational trauma and one was due to tuberculosis. The mortality experience after 10

years from hire of the men in Groups 2 and 3 combined is presented in Table 2.

TABLE 2: Mortality Among Men Employed 1 To 10 Years

	Time From First Employment								
	10-19 Years			20-29 Years			30+ Years		
CAUSE	OBS	EXP	SMR	OBS	EXP	SMR	OBS	EXP	SMR
All Causes	4	3.56	-	2	3.88	52	0	0.17	-
All Cancer	0	0.78	0	0	1.05	0	0	0.05	-
Lung Cancer	0	0.25	0	0	0.38	0	0	0.02	-
GI Cancer	0	0.17	0	0	0.22	0	0	0.01	-
Respiratory Disease	0	0.14	0	0	0.18	0	0	0.01	-
Ischemic Heart Disease	3	1.17	270	0	0.18	0	0	0.06	-

NOTE: When Observed and Expected differ by less than 1 an SMR is not reported.

No deaths of cancer or respiratory disease were observed in this group. The mortality experience of men employed 10 years or more is presented in Table 3.

TABLE 3: Mortality Among Men Employed 10 Years or More

	Time From First Employment								
	10-19 Years			20-29 Years			30+ Years		
CAUSE	OBS	EXP	SMR	OBS	EXP	SMR	OBS	EXP	SMR
All Causes	5	6.13	82	14	15.1	93	26	15.8	165
All Cancer	2	1.20	-	5	3.63	140	7	4.17	170
Lung Cancer	0	0.35	0	3	1.24	240	3	1.48	200
GI Cancer	1	0.31	-	0	0.85	0	2	0.92	220
Respiratory Disease	1	0.25	-	2	0.83	240	2	1.03	-
Ischemic Heart Disease	1	2.43	41	4	5.96	67	8	6.00	130

NOTE: When Observed and Expected differ by less than 1 an SMR is not reported.

There is a substantial excess mortality in the period following 30 years from first employment. Increased mortality from cancer, respiratory disease, and ischemic heart disease contribute to the excess. In addition, there were 4 traumatic deaths where 0.7 would have been expected.

One death in the period 20-29 years from first employment was a squamous cell cancer of the skin of the scrotum occurring in a 57 year old man who had been employed as a lathe operator. This disease has a well-known association with coal tar pitch. Another man died of "mycosis fungoides", a malignant lymphoma involving the skin. No cause of this disease has been identified by medical researchers, and, although the man worked as a pitch unloader toward the end of his life, it is not possible to make a statement about causation.

Occupational diseases, and occupational cancers in particular, are generally recognized to require many years for

expression. Table 4 thus presents the mortality experience of the various occupational groups for the period 20 or more years from first employment.

TABLE 4: Mortality 20 or More Years From First Employment

	Length of Employment								
	< 1 Year			1-10 Years			10+ Years		
CAUSE	OBS	EXP	SMR	OBS	EXP	SMR	OBS	EXP	SMR
All Causes	0	1.45	0	2	4.05	49	40	30.9	130
All Cancer	0	0.30	-	0	1.10	0	12	7.8	150
Lung Cancer	0	0.08	-	0	0.40	-	6	2.72	220
GI Cancer	0	0.06	-	0	0.23	-	2	1.77	-
Respiratory Disease	0	0.07	-	0	0.19	-	4	1.86	215
Ischemic Heart Disease	0	0.39	-	0	0.24	-	12	12.0	100

NOTE: When Observed and Expected differ by less than 1 an SMR is not reported.

Excess mortality is confined to the group with 10 or more years of employment. A doubling of the risks of death from lung cancer and respiratory disease was observed. No tests of statistical significance are presented here because the numbers of deaths expected are so small that an increase in risk would have to be large before statistical significance could be achieved.

3) Case-Control Analyses

Having found increased mortality from lung cancer and respiratory disease among the longer term employees, a case-control analysis was undertaken in an attempt to identify employment-related factors contributing to the excess. Three controls were selected for each man dying of lung cancer or respiratory disease from among all members of the cohort. Controls were matched as closely as possible on age (at most to within 5 years) and it was required that the control survive the case. When more than 3 men were eligible as controls for each case, 3 were selected by the use of random numbers. Conditional maximum-likelihood estimates of the relative risk parameters were calculated using the program "PECAN". When relative risk could not be calculated because none of the controls had worked at a particular job, Fisher's Exact Test was used to assess the association between work at a job and death from lung cancer or respiratory disease.

A) Lung Cancer

There were 6 deaths of lung cancer in the cohort. There were no substantial differences between the cases and controls in year of hire or length of employment. In looking for associations with occupation, the occupations mentioned by the Royal Commission witness, namely beater operator and lift-truck driver were examined first. Three of the 6 cases (50%) had worked at some time as beater operators compared with 2 (11%) of 18 controls. The maximum -likelihood estimate of the relative risk of lung cancer for men who had worked as beater operators (in comparison with employees who had never worked as beater operators) was 7.2 (95% Confidence Interval: 2.25 - 23.3). None of the cases had lift-truck operator mentioned as an occupation.

In scanning the list of occupations of the cases (Table 5) it was noted that two (33%) of the 6 men with lung cancer, but none of the 18 controls had worked as maintenance engineers or mechanics. This association between lung cancer and maintenance work is of borderline statistical significance ($p = 0.054$;

Fisher's Exact Test) but it must be remembered in assessing this p-value that the association was not hypothesized prior to examining the data. There was no significant association between work as a forming operator and the risk of lung cancer.

B)Respiratory Disease

The deaths of four men were attributed to emphysema, a disease not usually associated with exposure to asbestos. The men dying of emphysema had been employed an average of 17 years in comparison to an average of 28 among the men dying of lung cancer, but in comparison with the matched controls, there were no substantial differences in year of hire or length of employment. Two of the four men dying of respiratory disease had worked as beater operators, but none of the 12 controls had done so. The association between employment as a beater operator and death from respiratory disease was statistically significant ($p = 0.05$; Fisher's Exact Test). One of the 4 men had worked as a lift truck operator, as had 3 of the 12 controls. None of the cases had been employed as maintenance workers; one control had worked as an electrician.

Smoking histories were not available for any of these men.

Table 5: Occupations of the Men Dying of Lung Cancer or Respiratory Disease

Cause of Death	Year Hired	Length of Employment	Jobs Held
Lung Cancer	1949	12 Years	Maintenance Mechanic
Lung Cancer	1930	39 Years	Forming Operator
Lung Cancer	1952	21 Years	Maintenance Engineer
Lung Cancer	1944	28 Years	Forming Operator Oven Operator Straightener Beater Operator
Lung Cancer	1946	34 Years	Straightener Beater Operator Forming Operator Oven Operator
Lung Cancer	1955	14 Years	Beater Operator Forming Operator Treating Operator
Emphysema	1946	19 Years	Oven Operator White Sawyer Straightener Beater helper
Emphysema	1952	18 Years	Labourer Shipping
Emphysema	1952	18 Years	Shipping Tractor Driver Lift-Truck Black Sawyer Tooling Operator
Emphysema	1947	13 Years	Straightener Beater Helper White Sawyer Lathe Operator

DISCUSSION

Workers at the Domtar plant in Cornwall were exposed to 2 well known carcinogens, coal tar pitch and asbestos. It appears that at least 2 deaths among the workers, a skin cancer of the scrotum and a mesothelioma of the pleura, were caused by these agents. In addition, there was excess mortality among the long term employees from both lung cancer and non-malignant respiratory disease, diseases potentially associated with exposure to asbestos. Case-control analyses found significant associations between death from these diseases and employment as a beater operator (or operator's helper), an occupation specified by the Royal Commission witness as being one in which workers had particular risk of exposure to asbestos.

Both lung cancer and respiratory diseases are associated with cigarette smoking. We do not have smoking data for the cohort as a whole and so are unable to adjust for the influence of this factor. If Domtar workers smoked more heavily than the Ontario population in general, this might account for some of the excess risk found in the cohort study. It is unlikely, however, that there would be substantial smoking differences among the various occupational groups at the factory, and differences in smoking would not explain the associations with job found in the case-control analyses.

Several features of this study are worthy of note. Because the records of workers who had left employment prior to 1960 had been lost, this is a study of mortality of workers who were employed during 1960 or later. There is no way of knowing how the mortality experience of those who left the Company before 1960 might compare with that of their fellows who continued to work at Domtar and entered this cohort.

Deaths among cohort members were ascertained primarily from 2 sources; notification by the Company and the linkage to the Mortality Data Base at Statistics Canada. The Statistics Canada linkage is a probabilistic procedure, and deaths occurring among cohort members might be missed if there is disagreement between information on the death certificate and the employment record. Deaths among shorter-term workers are

less likely to be known to the Company and more reliance is thus placed upon the linkage to determine the fact of death. This might account, in part, for the observation of fewer deaths than expected among workers with less than 10 years of employment (Table 4).

It may reasonably be concluded that exposure to asbestos has caused some excess mortality among the Domtar workers. Men who worked as beater operators or maintenance mechanics appear to be at particular risk.

The following actions in follow-up might be worthwhile:

1) It is known that cigarette smoking increases the risk of disease among workers who have been exposed to asbestos and it is believed that smoking cessation will cause this increased risk to decline. It is thus suggested that Domtar employees who worked with asbestos be contacted, informed of the results of this study and advised about the hazards of smoking. It is suggested that particular effort be made to locate men who worked as beater operators or maintenance mechanics, to provide them with counselling about smoking, and to offer them a clinical examination to detect asbestosis, a compensable industrial disease.

2) The names of workers who died of lung cancer or respiratory disease will, with the permission of the Registrar General, be provided to the Ontario Workers' Compensation Board for their consideration.

3) It is suggested that the Ontario Cancer Registry be asked to periodically examine their records for the names of workers in this cohort so that the Compensation Board may be informed of cases of potentially compensable illness.